United States
Environmental Protection
Agency

Region 5
77 West Jackson Blvd.
Chicago, Illinois 60604

Illinois, Indiana,
Michigan, Minnesota,
Ohio, Wisconsin

EPA

FACT SHEET

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Contaminated Sediments

What are sediments?
Sediments are the unconsolidated materials on the bottoms of rivers and lakes. Sediments consist primarily of clay, silt, sand, and gravel along with some organic material from decomposing plants and animals. To this mixture human activities have added toxic chemicals such as pesticides, herbicides, and PCBs; heavy-metals, such as lead and mercury; and other pollutants such as ammonia and cyanide.

Why are contaminated sediments a problem?
Sediments contaminated by toxic organic compounds and heavy-metal pollutants represent a potential threat to human health, aquatic life, and the environment. Unfortunately, the degradation rates of some toxic contaminants are so slow that these chemicals tend to remain in the sediments for long periods of time.

Creatures that live on the bottoms of rivers and lakes (such as crustaceans and insect larvae) can ingest or absorb toxic chemicals from contaminated sediments in their environment. These animals form the base of the aquatic food chain and problems that affect them can affect the entire fish and wildlife population.

Contaminants in sediments can also affect humans directly through the food chain. When small fish and shellfish eat contaminated materials, the contaminants collect in their bodies. When larger fish eat the smaller ones, the contamination is passed on. Eventually, important fish species like lake trout and wildlife like ducks are affected. Humans can be at risk by eating contaminated fish and wildlife.

Sediments can be transported by moving waters. In particular, sediments can be affected by storms, which can pick up and carry sediments for long distances. For example, rivers flowing into the Great Lakes carry large amounts of sediments into the Lakes every year. If these sediments are contaminated, the contamination will also be carried into the Lakes.

What can be done about contaminated sediments?
This will vary from site to site. Options range from leaving them in place to removing or isolating them by various methods.

Should the contaminated sediments be removed?
If contaminated sediments are a threat to human health, aquatic life, and the environment, or interfere with navigation, the sediments need to be removed. Contaminated sediments are removed by dredging; that is, by digging them up and moving them to another location. There are three major types of dredging, each of which has its advantages and disadvantages. Which type is used will depend on the specific situation.

The oldest type of dredging is **mechanical dredging** in which sediments are removed with a type of scoop. This method can be precise and picks up the least amount of water with the sediments. However, it can cause resuspension of sediments (unless more modern, tighter dredges are used). The second type of dredging uses a hydraulic suction pump, sometimes with cutter blades, to pick up sediments along with water. Using **Hydraulic dredges** can minimize resuspension, but they pull up a large amount of water with the sediments. The third type of dredging uses compressed air to pneumatically lift the sediment. **Pneumatic dredges** pick up less water than hydraulic dredges, but they do not work well in shallow areas such as near lakeshores or coastlines.

What are the disposal options?
Before dredging, a decision must be made on how to dispose of the dredged material. The simplest option is to dump the material in a large lake or in the ocean. However, this option is not acceptable for contaminated sediments.

A second option is to place the dredged contaminated sediments in a Confined Disposal Facility (CDF). These are diked areas usually built in shallow water, but sometimes on land, in which the dredged material can be placed and confined. Some CDF's have walls lined with materials that keep the sediment isolated, while allowing water to move through. Other CDF's restrict the movement of water as well.

A third option is to place the contaminated sediments in a CDF designed to function like a hazardous waste landfill. Although this method is used for highly contaminated sediments, it is very expensive for large amounts of dredged material.

What are the Treatment options?
A variety of methods to treat the most contaminated sediments is being studied and tested. Some are quite expensive. No single method has proven to be superior to others and each site may suggest a different approach or combination of approaches. Most of the methods require excess water to be removed from the sediments prior to treatment.

One treatment approach is separation that removed contaminants from the rest of the sediments. The most common method is separation by grain size, because contaminants tend to stick to the smallest particles in sediments. Other methods use heat to separate an oily fraction, which contains most of the toxic organic compounds. In some cases metals can be removed by magnetic devices.

Another treatment approach is to destroy the contaminated material. Incineration is commonly used to destroy many organic contaminants after separation, while other contaminants can be destroyed by chemical or biological means.

In some cases, sediments can be solidified by adding a setting agent such as cement or kiln dust. This can prevent certain types of material from interacting with the environment.

Finally, some sediments can be treated by allowing bacteria and fungi to biodegrade organic contaminants. This process, called bioremediation, can occur either in place or after dredging, depending on the specific conditions at the site. Bioremediation is not effective for PCB's.

Unfortunately, advanced treatment technologies tend to be expensive and this limits the volume of sediments can be treated by these methods. The specific circumstances at each site will suggest the combination of dredging, treatment, and disposal options employed there.

Can the sediments be left in place?
Leaving sediments in place may be the best solution if they do not affect human health and the environment, if the sources of contamination have been eliminated, erosion of the sediments is unlikely, and clean material is being deposited on top of the contaminated material. In time, the contamination may be naturally capped by the layer of clean sediment and isolated from disturbance by storms, floods, or burrowing organisms.

If a clean material does not buildup fast enough naturally, and erosion is unlikely, it may be possible to cap the contaminated sediments artificially. Capping the sediments can confine the contaminants and keep them from interacting with the environment. Capping is done with substances such as clay, sand, or gravel that create a physical barrier between the contaminated material and the overlying waters. However, capping has not been proven in some places, like the Great Lakes and its rivers, where constant shifting of bottom sediments creates unfavorable conditions for such an approach.

However, doing nothing (the “no action” alternative) may be unsafe. The contaminated sediments may be picked up, especially during floods or by wave action, and transported elsewhere. Or, if the sediments lie in a navigation channel, they can be stirred up by passing ships and resuspended. Resuspension of contaminated sediments is of greatest concern when such material is carried into cleaner areas such as one of the Great Lakes or a coastal estuary where the contamination can pose a substantial health risk to aquatic organisms and fish.

Finally, although many organic contaminants degrade with time, this process can be very slow and other contaminants -- such as heavy-metals -- do not degrade at all. Because the contamination can persist for a very long time, solutions must achieve long-term control of the risks posed.

What can be done to prevent contaminated sediments?
Sediment contamination is the result of past discharges from point (industries and municipalities) and non-point (agricultural and urban runoff, air deposition, etc.) sources. Although in recent years pollutants in these discharges have greatly decreased, and in some cases been eliminated, additional controls and prevention measures are needed to assure that new sediment contamination is not created.

What is EPA doing about contaminated sediments?
The Environmental Protection Agency (EPA) is developing a national strategy to deal with contaminated sediments. Its goals are to prevent future sediment contamination; to manage existing sediment contamination by using pollution prevention, source controls, and natural recovery where appropriate; and to remediate high risk sites where natural recovery will not occur or is too slow.

There is a variety of regulatory tools available to achieve these goals. For example, the Clean Water Act, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, commonly known as Superfund) and the Resource Conservation and Recovery Act (RCRA) cover releases of contaminated substances into sediments. The Toxic Substances Control Act (TSCA) regulates PCB’s and other toxic substances, and requires that sediments containing certain levels of PCB’s be cleaned up. The Clean Water Act (CWA) can also be used to require that a permit be obtained from the U.S. Army Corps of Engineers before any material can be discharged into a body of water. In addition, States have their own authorities to regulate contaminated sediments.

For more information contact:

U.S. Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604
1-800-621-85431 or (312) 353-2072